REMARKS

Drawings

The Office previously objected to the filed drawings as being informal, and a set of substitute drawings were submitted for replacement in the response filed Feb. 2, 2006. The Office did not make any further objection, so the Applicant will assume that the replacement drawings were accepted and would appreciate a notation of acceptance in further communications.

Claims Rejections - 35 USC §102(b/(e))

The Office rejected claims 1 -20 under 35 U.S.C. 102(b) as being unpatentable over Martin (U.S. Pat. No. 6,469,358); the Office rejected claims 1, 5-12 and 14-17 under 35 U.S.C. 102(e) as being anticipated by Mitra (U.S. Pat. Appl. No. 2004/0108564); the Office further rejected claims 1, 5-12 and 14-17 under 35 U.S.C. 102(b) as being anticipated by Claiborne (U.S. Pat. No. 6,452,187).

Applicant does not acknowledge these references to be prior art based on the priority claim, however the amended claims reflect features that are not anticipated by these references and Applicant believes that the rejections are traversed.

As previously recited, a rejection based on anticipation requires that a single reference teach every element of the claim (MPEP § 2131). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) Or stated in another way, a "claim is anticipated only if each and every element as set forth in the claim is found, . . . described in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

In more particular detail, the Office refers to Martin Col 8, lines 2-23 (Col. 8 lines 3-38 are recited herein for convenience, emphasis added):

Optical coupling, in accordance with exemplary embodiments of the invention, can be achieved using a number of different techniques. Principles of quantum selection require that incident electromagnetic fields propagate in the horizontal plane of the quantum well. The incident flux must therefore be reflected inside the quantum well at an angle such that the flux passes through the material many times. In one exemplary embodiment, a rotated waffle diffraction grating is used, where the width of the waffle corresponds to one wavelength, the length of the waffle to another, and the diagonal to a third wavelength. The waffle grating, combined with a top side grating and side wall reflecting mirrors, constitute the optimum "photon in a box" quantum well detector optical system. Additionally, the waffle grating can be enhanced with a flux entry side anti-reflective coating composed of, for example, a quarter wavelength dielectric material. In addition to the waffle grating, one skilled in the art will recognize that a number of different techniques can be used for achieving optical coupling in the present invention. Such techniques include use of random gratings, reflectors, resonance structures, and so forth.

As one skilled in the art will recognize, a plurality of the vertically stacked detector structures described in the exemplary embodiments above can be formed across an etch stop layer to provide a detector structure array. This array will serve as a focal plane for optics of an IR imaging system. Such optics are conventionally known in the art and are not described here.

One skilled in the art will additionally recognize that the detector and ROIC can be fabricated as integral structures in the focal plane array. Using this fabrication technique, the detector and read out circuitry can be fabricated as a unitary structure, thus removing the need for aligning the detector array structure and the ROIC array structure so as to connect each ROIC, via conductive bumps, with its associated detector across the array.

It appears that Martin is referring to a three color quantum well FPA wherein the term 'waffle' refers to some array of quantum wells wherein the length, width, and diagonal of the waffle are different such that the length, width and diagonal correspond to three respective wavelengths. The Applicant submits that the limited description for the waffle in Martin is lacking in specificity and detail such that one skilled in the art would not readily comprehend any form of waffle structure without undue experimentation and therefore is inoperable as a prior reference for the features relied upon by the Office. There are no figures and no details in Martin as to how one would build such a grating structure. Furthermore, the angles of orientation are not discernable from the Martin description.

"In determining that quantum of prior art disclosure which is necessary to declare an applicant's invention 'not novel' or 'anticipated' within section 102, **the stated test is whether a reference contains an 'enabling disclosure'**... ." *In re Hoeksema,* 399 F.2d 269, 158 USPQ 596 (CCPA 1968). A reference contains an "enabling disclosure" if the public was in possession of the claimed invention before the date of invention. "Such possession is effected if one of ordinary skill in the art could have combined the publication's description of the invention with his [or her] own knowledge to make the claimed invention." *In re Donohue*, 766 F.2d 531, 226 USPQ 619 (Fed. Cir. 1985).

Therefore, if the Office asserts Martin, the Office must show that Martin has an enabling disclosure of the desired subject matter - mere naming or description of the subject matter is insufficient, if it cannot be produced without undue experimentation. *Elan Pharm., Inc. v. Mayo Found. For Med. Educ. & Research*, 346 F.3d 1051, 1054, 68 USPQ2d 1373, 1376 (Fed. Cir. 2003). The Applicant does not believe that the reference in Martin to the 'waffle' satisfies the criteria of an enabling disclosure.

Martin describes that "*in one exemplary embodiment, a rotated waffle diffraction grating is used, where the width of the waffle corresponds to one wavelength, the length of the waffle to another, and the diagonal to a third wavelength.*" Thus according to the Martin waffle structure – the "width" of the waffle corresponds to one wavelength - the "length" of the waffle

corresponds to a second wavelength - and, a "diagonal" corresponds to a third wavelength. The relationship between the length, width, and diagonal and the respective wavelength is not sufficient to form the grating structure.

In addition, such a structure is clearly distinguished from the structure of the amended claims of the present invention. The claims have been amended to clarify the present waffle structure, wherein a surface area of the wells is about approximately equal to a remaining surface area of the backside, and a pitch of the wells is about one wavelength of a center wavelength of interest.

Applicant submits that amended claims 1, 11 and 17 traverse the rejection and allowance is respectfully requested.

With respect to claim 2, Martin notes that *"[t]he incident flux must therefore be reflected inside the quantum well at* ***an angle*** *such that the flux passes through the material many times.* There is no further description or suggestion as to what angles 0 – 360 degrees might be applicable. While the Office argues that "an orientation of about 20-70 degrees" would be considered an obvious optimization of waffle grating rotation – Applicant respectfully disagrees with the Office's official notice and requests the Office substantiate this position.

If it were obvious, then it should be easy to find a reference that suggests the elements as recited in claim 2, namely, wherein the pattern of the waffle-type light-coupling grating has a geometry optimized for a center wavelength of interest, and an orientation ranging from about 20 to 70 degrees with respect to a major edge of the pixel.

Furthermore, the reference to a 'rotated waffle' at some 'angle' is not enabling without undue experimentation and therefore cannot be used as a prior art reference with respect to orientation.

As noted in the prior response, it was not until the present inventors experimented with the waffle fabrication that the surprising results of the improved performance of the waffle pattern as compared to the post pattern was evident as shown in Figures 8a-8d of the present application illustrating the Conventional (Post) versus the Optimized (Waffle). The inventors built the structures for the test data collected in Figures 8a – 8d and experimented with the orientations and were impressed with the significant increase in the quantum efficiency with an improved conversion efficiency. The waffle grating improves the light absorption of the quantum wells with respect to the post grating and further improvements were obtained by rotating the waffle grating. Thus even those skilled in the art were surprised at the improvements of the waffle grating as compared to the post grating.

As explained, a pixel is a complicated three dimensional cavity with respect to electromagnetic waves. Looking at the waffle grating surface from inside the pixel, the electromagnetic waves 'see' a periodic array of reflector islands (Fig. 6b - lower level 66) closer to the quantum wells and the reflector grid (Fig. 6b - upper level 62) further away from the quantum wells.

Examiner is kindly reminded that "assertions of technical fact in areas of esoteric technology must always be supported by citation of some reference work" and "allegations concerning specific knowledge of the prior art, which might be peculiar to a particular art should also be supported." MPEP § 2144.03. The Applicant notes that a reference that merely discloses or suggests the general concept of rotation of the waffle is not sufficient to establish a prima facie case of obviousness. Rather, the reference or references must disclose or suggest some angular number/range or teaching as to how to derive such angles as defined by the Applicant's amended claim 2.

Applicant believes that the rejection of claim 2 has been traversed and respectfully requests allowance. In addition, claim 4 that recites an angle of about 45 degrees should be allowable.

Regarding claim 3, which recites that the geometry includes a well depth of about one quarter wavelength of the center wavelength of interest. Martin describes a structure having a width corresponding to one wavelength, a length corresponding to another wavelength, and a diagonal corresponding to a third wavelength. There is no description in Martin of a well depth thus, Applicant believes that the rejection of claim 3 is traversed.

Mitra is used for a 102(e) rejection of claims 1, 5-12, and 14-17. As detailed herein, the claims have been amended to clarify that the present invention includes a waffle grid grating wherein a surface area of the wells is about approximately equal to a remaining surface area of the backside. Mitra describes a detector array for multiple wavelengths including multiple sub-pixel arrays – each array being different (Mitra page 5, par. [0047]). A further description of Mitra explains the operation such that multi-spectral pixel photodetectors (Mitra Fig. 9, elements 908, 910, 912, 914) each absorb three different bands and the total results in 12 different bands.

In distinction, the present invention claims a photo detector array wherein the surface area of the wells is about the same as the surface area of the remaining backside or grid. The present invention also claims the structure having a pitch of the wells being about one wavelength of a center wavelength of interest. Mitra is intended for multiple wavelengths and the corresponding structure is therefore necessarily different. While Mitra discloses multiple embodiments, the Applicant did not locate any Mitra Figure or description having the surface area of the well approximately equal to the surface area of the grid. (See Mitra Fig. 5 and Fig. 6)

For at least these reasons, the Applicant believes that the rejection has been traversed and allowance is requested.

Claiborne is also recited by the Office in rejecting claims 1, 5-12, and 14-17. Claiborne describes the formation of a two-color photodetector. There does not appear to be any reference or intention to have a structure wherein the surface area of the wells is about approximately equal to a remaining surface area of the backside such as claimed in the present invention. In

addition, while Claiborne details periodic structures for two colors, there appears to be no description of a pitch of the wells being about one wavelength of a center wavelength of interest.

Furthermore, neither Mitra nor Claiborne describe or indicate any orientation preference such as detailed and claimed in the present invention such as claims 2, 4, and 11.

For at least the reasons recited herein, the Applicant believes that the rejections are traversed and allowance is requested.

Claim Rejections – 35 USC § 103

The Office has quoted the statute from 35 USC 103(a), which is referenced herein. The Office has rejected claim 1 – 20 as being unpatentable over Faska (U.S. Published App. No. 2002/0008191; now U.S. Pat. No. 6,875,975) in view of Martin. In the alternative, the Office has also rejected claims 1-20 as obvious over Martin; claims 1, 5-12, and 14-17 are rejected as obvious over Mitra; and claims 1, 5-12 and 14-17 are rejected as obvious over Claiborne.

Applicant does not acknowledge these references to be prior art, however the amended claims more clearly distinguish the present invention and Applicant believes that the rejections are traversed.

In addition, while the Applicant acknowledges that the present application is a CIP of the parent application (Faska), the Applicant does not acknowledge that the waffle grating is 'new matter' with respect to Faska as stated by the Office.

Faska describes certain aspects of the waffle grating in an enabling manner, wherein the structure for the waffle having a surface area of the wells about equal to the surface area of the grid is clearly described as is the spacing or pitch being a wavelength in each direction. As the description was enabling in the parent application (Faska), the priority claim under 35 USC 120

for the Continuation-in-Part (CIP) of the present application removes such features as eligible as prior art under 35 USC 102(b).

The present application contains clarifications and details as to the range of angles for orientation that were refinements invented during empirical testing and evaluation. Thus, Applicant submits that on a claim by claim basis, Faska is not a prior art reference for at least claims 1, 11, and 17 due to the enabling description which is recited herein for reference: (Col. 5, lines 4-63) (emphasis added)

> *Referring to Figs. 2 and 6, the distance that light travels in the relatively thin detector layers of the invention is increased significantly by first etching in relief and then coating a refractive pattern 60, in the form of a grid or* ***waffle pattern****, on the top of the final or backside contact layer 50. This refractive pattern 60 reflects a substantial portion of the light coming straight into the detector in a direction normal to the path of entry, dispersing it edgewise through detector layers 20 and 40 so as to maximize the exposure of the detector layers semiconductor materials to the light. The geometry and orientation of the pattern, including the size, height, and spacing of the steps or wells of the grid, is optimized for the center wavelength of interest. The depth or relief of the etching is one quarter wavelength of the wavelength of interest; the spacing or* ***pitch of the lines of the pattern is a wavelength in each direction****.*
>
> *The top or unetched portion 62 of refractive pattern 60 is first treated with an AuSnAu deposition coating for electrical bonding of a contact pad. The full pattern 60 is then coated with a gold mask, assuring that sidewalls 64 and lower, etched level 66 of the pattern is directly gold coated to achieve a smoother, more reflective quality with respect to the interior side of the coating. The AuSnAu deposition is limited to the top surface 62 where bonding is necessary, because tin (Sn) tends to permeate the surface of the semiconductor material, leaving a rough texture to the coating interface on the contact layer that degrades the reflective properties of the coating.*

The pixel edges of the detector layers are likewise gold coated to reflect the refracted light vectors repeatedly back into the detector layers for maximum exposure of the detector layer material to the available light. The thin layers, refractive pattern and associated reflective coatings create in effect what one might refer to as an open face "photon box," in which light enters the face, is refracted at right angles off the backside of the box, and is hence reflected from side to side within the box.

In the preferred embodiment a simple square grid pattern 60 is used. The grid may be etched leaving the squares 62 in relief, as shown in Fig. 6, or alternatively, the squares may be etched leaving the grid lines in relief, as in a ***waffle pattern. The resultant surface area of each level is about equal****.*

The refraction effect of the square pattern on light entering the detector tends to be bi-directional, oriented with the lines of the pattern, so the pattern is preferably diagonally oriented with respect to the edges of the pixel so planar light vectors are initiated at angles other than perpendicular to the edges of the pixel. This further enhance edge reflection properties within the detector layer, bouncing the light vectors around the box rather than straight back and forth between opposing sides.

The indium bump or contact 51 for contact layer 50, the top or final contact layer, is set on squares 62, the higher or ***unetched level of pattern 60, the nominally 50% surface area of the unetched portion of the pattern****, bridging the lower level 66 troughs or wells of the pattern. A close up view of the refractive pattern is illustrated in cross section in Fig. 2 and in partial perspective view in Fig. 6.*

According to the MPEP §2143.01, "[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either the references themselves or in the

knowledge generally available to one of ordinary skill in the art." A useful presentation for the proper standard for determining obviousness under 35 USC §103(a) can be illustrated as follows:

1. Determining the scope and contents of the prior art;
2. Ascertaining the differences between the prior art and the claims at issue;
3. Resolving the level of ordinary skill in the pertinent art; and
4. Considering objective evidence present in the application indicating obviousness or unobviousness.

With respect to the obviousness rejection based on Faska in view of Martin, Faska should be removed as a prior art reference for at least claims 1, 11, and 17 as noted herein. With Faska removed as a prior reference, the Martin reference does not obviate or otherwise negate the features of claims 1, 12, 17 as detailed herein, wherein the surface area of the wells is about the same as the surface area of the remaining backside, and these claims should be allowable. Martin also clearly does not indicate the orientation angles of claims 2, 4 and 11. As detailed herein, Martin is not an enabling disclosure for such angles.

With an allowable base claim, dependent claims should also be allowed. For at least the reasons set forth herein, the rejection based on Martin should be traversed.

With respect to Claiborne and Mitra, both of which are similar in many respects, these references fail to describe, alone or in combination, the amended claims wherein a surface area of the wells is about approximately equal to a remaining surface area of the backside. In addition, these cited references do not describe having a pitch of the wells that is about one wavelength of a center wavelength of interest. These references use the length/width of the structure as well as other recited features to enable multiple bandwidth detection. Furthermore, neither Claiborne nor Mitra disclose or suggest any angular orientation of the grating such as the 20-70 degree range or the 45 degree angle.

Applicant believes that all rejections have been traversed and allowance is respectfully requested.

The Office has made broad rejections using multiple references with little description as to specific details that would enable the Applicant to better comprehend the rejections and

formulate a response. Applicant respectfully requests that the individual rejected claims include detailed description of the rejection and the specific reference, preferably with page/paragraph number, in order for the Applicant to be more concisely focused.

Telephone Interview

If allowance of all claims is not granted, Applicant respectfully requests that the Office contact the under-signed to discuss any further remaining issues. The Applicant believes that a telephone discussion will likely expedite processing and result in allowance.

Applicant believes the above amendments and remarks to be fully responsive to the Office Action, thereby placing this application in condition for allowance. No new matter is added. Applicant requests speedy reconsideration, and further requests that Examiner contact its attorney by telephone, facsimile, or email for quickest resolution, if there are any remaining issues.

Respectfully submitted,

/Scott J. Asmus, Reg. No. 42,269/

Cus. No. 42716
Maine & Asmus
PO Box 3445
Nashua, NH 03061-3445
Tel. No. (603) 886-6100, Fax. No. (603) 886-4796
patents@maineandasmus.com

Scott J. Asmus, Reg. No. 42,269
Andrew P. Cernota, Reg. No. 52,711
Attorneys/Agents for Applicant